AEROSPACE ENGINEERING
COLLEGE OF ENGINEERING

RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

APPLICATION DEADLINE: February 8, 2026

PROJECT TITLE: Global Shear Stress Measurement in Supersonic Flow using Liquid Crystals

Physical Requirement :
Must be able to lift 20 lbs and be a US citizen

Project's Technical Skills Requirement :
Work with hand tools and klowledge of pthon coding and data acquisition systems

Project's Available Positions : 1

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Project Description

In order to predict the performance and structural requirements of supersonic/hypersonic aircraft it is essential to have accurate knowledge of both skin friction and heat transfer characteristics on the vehicle surface. Typically, the flow regimes include turbulent boundary layers which provide air resistance to the flow thereby producing skin friction which is responsible for the viscous drag of the aircraft. Skin friction is a major component of drag for supersonic and hypersonic aircraft and up to the present, little prospect of reducing it. Similarly, heat transfer created by skin friction also presents difficulties in the design and performance of materials selected for aircraft construction.

There are numerous methods available to determine skin friction magnitude. For example, wall hot wire, wall pulsed wire, surface fences are techniques for estimating skin friction at a single location, whereas oil-film interferometry can provide estimates over a much larger surface area. Although these techniques have been used on attached and separated fully developed turbulent boundary layers, all have had limitations to low-speed to mid-speed applications rather than at supersonic and hypersonic speeds.

The current project involves participation in a multiyear Navy Hypersonic program wherein our team is measuring the full field shear stress using liquid crystals on flat plates at Mach 4. In this next stage the team begin to modify the technique for curved surfaces and then into hypersonic regime

with the fabrication of a second Mach 5 tunnel.

This topic is open to all CEAS students. Although training will be provided, basic skills needed include experience with coding, such as python, LabVIEW, etc. and being a team player is required. Comfortable in a large-scale laboratory environment. In addition, there is a potential for the student to participate in technical publications at local and national levels. Dr. Disimile’s UC-FEST laboratory is located off campus in Fairfield, Oh, approximately 30 minutes north of UC.